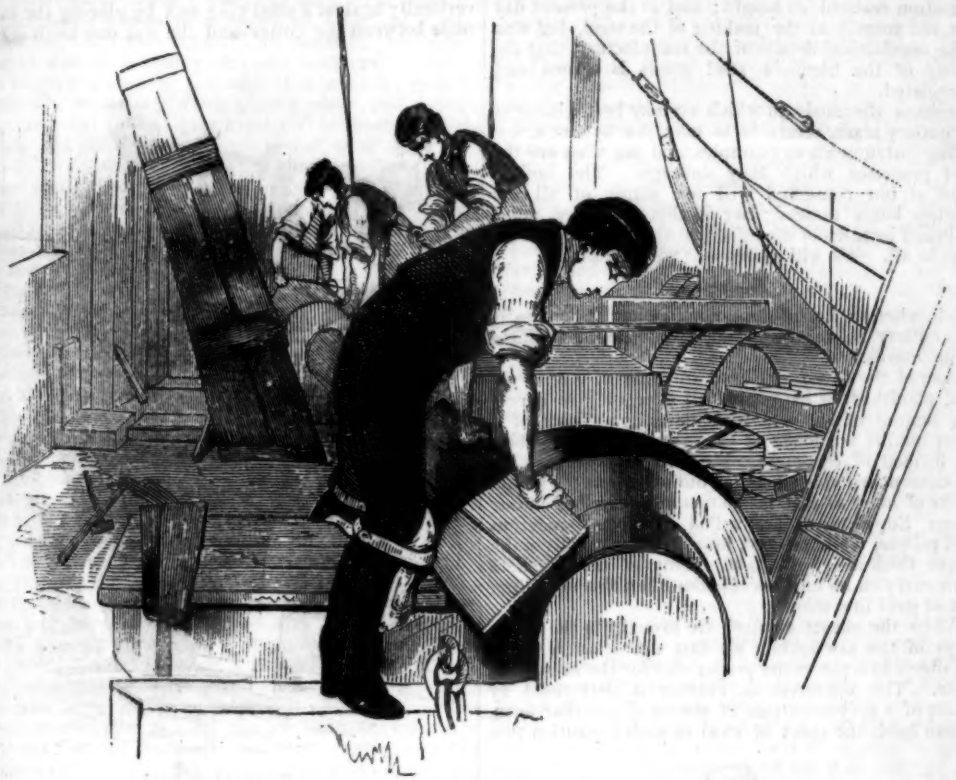
A DAY AT THE SHEFFIELD CUTLERY-WORKS.



[Saw-Grinders.—Sheffield Grinding-Mills.]

In the Supplement for March, relating to the Steel-Works of Sheffield, we had occasion to notice some of the peculiarities of that town as a centre of manufactures. But we must now view it more closely. We must regard it as one great workshop for the production of cutlery and edge-tools—a huge factory which scatters its separate departments in different parts of the town, but still retains them all, like so many links in a chain.

If we take a Directory of Sheffield as an index to the employments of its inhabitants, we shall see that, although the distinct occupations are very numerous, there is yet a tie which connects most of them together: cutting instruments, of some kind or other, being the objects to which most of the manufacturing arrangements relate. There are Cutlery Casters, Table-knife makers, Fork-makers, Penknife-makers, Lancet-makers, Razor-makers, Scythe-makers, Saw-makers, Edge-tool makers, Scissor-makers, Shear-makers, Spade and Shovel makers: preparatory to all these are the operations of the Steel-converters, and Tilters, and Rollers, and Casters; subsidiary to them are those connected with the making of handles, such as Ivory, Tortoiseshell, and Pearl-dealers, Ivory-cutters, Horn Merchants and Dealers, Horn-pressers, Bone Merchants and Dealers, Bone-pressers; and lastly, there are numberless minor occupations which contribute in various ways to the manufacture of cutlery, such as Casting-pot makers, Mark and Figure makers, Razor-strop makers, Studders and Handle-ornamenters, and many others. It is true that other manufactures are carried on to a considerable extent; for instance, the immense supply of steel at hand affords facilities for the production of various articles, such as fenders, wire, anvils, hammers; the large use of horn for handles has led to the settlement of the comb manufacture at Sheffield; the supply of bone for handles has given rise to button-mould making; and there are considerable manufactures in white metal, including silver and its various imitations. But still all these are so far outweighed by the arrangements connected with cutlery, that the latter must be deemed the staple, the characteristic, the distinguishing feature of Sheffield industry.

Like as in other instances, Sheffield has grown up to its present distinction by gradual advances. At the time when archery supplied the use of fire-arms throughout England, Sheffield is stated to have been celebrated for the manufacture of iron heads for arrows: and it was known by Chaucer as a place where blades of knives were made; for a character in one of his poems is mentioned as being furnished with a "*Sheffield thwytel*" (whittle), a kind of knife which used in those days to be carried about the person. Rather more than two centuries ago the principal cutlers formed themselves into a body corporate, for the protection of the trade, and especially for the protection of the 'marks' belonging to each individual, with a view to guard against the piracy of

these marks by persons to whom they do not belong. It was about a century ago that the cutlery of Sheffield began to acquire such decided excellence as to raise it to a high rank. But it was not until the introduction of the mode of making cast-steel that this reputation reached its height; and at the present day it is not merely in the making of the steel, but also in the mechanical details of the manufacture, that the quality of the Sheffield steel goods is shown and appreciated.

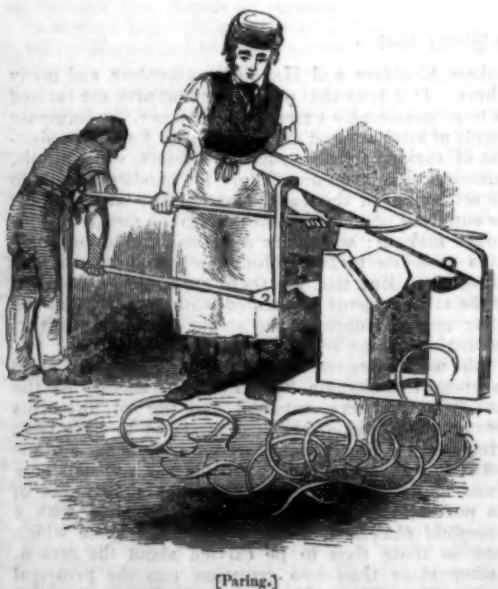
Perhaps the mode in which we may best glance at the cutlery manufacture is to take, one by one, a few cutting instruments as examples, and see what are the chief processes which they undergo. The limited space at our command will not admit of all the varieties being noticed; nor is this necessary, since the broad features of manufacture are pretty much the same in all. We will commence with a notice of

Saws;

which, whether included or not in what we generally term cutlery, hold an importance place among Sheffield manufactures.

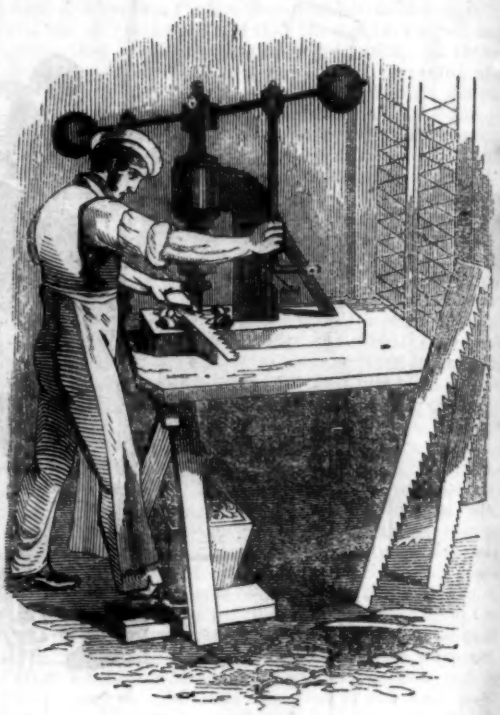
Saws of the commoner kind are made of thin sheet-iron, planished, or hammered all over to give a certain degree of stiffness and elasticity. Those of a better quality are made of shear-steel; while the best are formed of cast-steel. We will suppose that the last-named are the object of our attention. The flat ingots of steel, as cast in the manner described in our former Supplement, are rolled between ponderous steel rollers, while red-hot, into the form of sheets the proper thickness for a saw. Many of the Sheffield firms carry on no other occupation than this of rolling bars of steel into sheets.

When the sheets of steel are brought to the workshops of the saw-maker, his first operation is to cut the sheets into pieces the proper size for the saws to be made. This operation of cutting is performed by means of a very stout pair of shears of peculiar form. A man holds the sheet of steel in such a position that



[Paring.]

the shears may act upon it, moving the sheet from time to time as the cut extends; while another works the shears. The edges of the pieces of steel are then made quite straight by means of a grindstone; and matters are ready for the making of the teeth. This is not done by a file, as some may suppose; nor by stamping out all the teeth at one blow, as others may imagine; but each tooth is punched out separately. There is a kind of flat bench so arranged that a steel cutter works vertically against a steel die; and by placing the saw-plate between the cutter and the die, one tooth is cut



[Toothing Long Saw.]

out at each movement of the fly-press connected with the cutter. The saw-plate is then shifted a little, and another tooth cut out in a similar manner, and so on until the whole of the teeth are formed. These teeth of course vary in size and shape according to the kind of saw to which they belong. In the saws for an ordinary saw-mill the teeth are generally right-angled triangles; in the pit-saw the teeth are so formed as to meet the fibres of the wood at an acuter angle; while hand-saws and the generality of carpenters' and joiners' saws have teeth midway in form between the two other kinds. The teeth, after being cut, are finished up with a file, and the burr, or raggedness of the edge, is removed. The steel then undergoes the process of 'hardening,' which, at some stage or other, is the case with nearly all steel goods. The saws are laid flat in a furnace fitted for their reception, and heated to a degree determined by experience. They are taken out of the furnace, and immediately plunged into cold oil (or into some prepared liquid), whereby they are quenched, and made to acquire a sudden and very considerable degree of hardness.

When the saws, or 'plates,' as they are called, are removed from the hardening-trough, part of the oily mixture is wiped from the surface, while the remainder is dissipated by holding the saw over a clear coke fire; this heating at the same time gives the proper degree of temper or elasticity to the steel. While yet warm, the steel is hammered at different parts, to remove any warping or bending which it might have suffered. Then follows one of the most

noisy operations connected with the manufacture, viz. the 'planishing.' The saw is held in the left hand of the workman, rested on a small polished steel anvil, and hammered repeatedly on every part of the surface with a small hammer, whereby a clatter is produced from which a stranger gladly escapes. The object of this process is to make the saw true, even, and of equal elasticity in every part. The operation requires a great deal of dexterity; for the workman, by giving to the saw a kind of vibratory motion as he goes on, tests the elasticity and tension of the steel, and acquires by habit the tact of knowing where to strengthen the weaker parts by increasing the number of blows.

The saw is then carried to the 'wheel,' or grindstone, where both surfaces are ground all over, to reduce them to an even and regular state: this process having relation to the outer surface of the saw, while the planishing relates more to the internal texture. The grindstones employed for saws are of large size, sometimes as much as six or seven feet in diameter. The saw is too thin and flexible to be held against the grindstone as a knife would be; it is therefore fixed lightly to a board, and the board so held by the grinder (as sketched in our frontispiece) as to bring the saw in contact with the edge of the stone, shifting to and fro, until every part of both surfaces has been ground down level and true. As saws of the larger sizes could not be conveniently held in this way, they are suspended at both ends by cords from the ceiling, and swung backwards and forwards to bring them to the proper positions. The peculiarities attending this process are very exactly portrayed by Mr. Holland (in his Treatise on the Iron and Steel Manufacture), in the following words:—"It is not easy to conceive the idea of muscular exertion, imminent danger, and peculiarity of attitude presented to the eye; and the mind of an individual, who, unaccustomed to such a spectacle, looks at a saw-grinder when at work, standing on tiptoes over a great grindstone revolving with a fearful rapidity; his arms outstretched towards the extremities of the board under which lies the saw, and pressing against it with his knees to keep it in the closest contact with the surface of the stone; his person and dress appearing at the same time as if they had been dipped in an ochre-bed—present a picture of no common interest."

This grinding, though it gives one kind of regularity and equability to the saw, deranges it in respect to another; for the steel requires another planishing, or hammering on an anvil, to restore to it the flatness and straightness which the grinding had disturbed. After this second hammering, it is passed over a small coke fire till a particular and carefully tested degree of 'temper,' or elasticity, is given to it. Another grinding, but much slighter than the former, takes out the marks of the hammer, and gives a uniformity of appearance.

There next ensues a process so slight, so simple, and so soon ended, that it would seem hardly necessary to give it a separate place in the description; but it at the same time so remarkably illustrates the tact acquired by long practice, that a stranger is likely to be more struck with this than with any other part of the operations. If we look at the teeth of a saw, we shall see that half are bent in one direction, and half in the other; every alternate one being bent differently. This is done by the blows of a hammer, one blow to each tooth. The saw is rested flat on a steel anvil, and held by the left hand of the workman, who has a very small hammer in his other hand. With this hammer he strikes the sides of the teeth, one at a time; the weight of the hammer, the shape of the hammer-head, and the force of the blow, being just such as will enable one blow to give the required bending to the tooth. But the point worthy of note is the rapid and unerring manner in which the workman proceeds along the saw, *missing* every alternate tooth, striking one blow on each of the others, and yet advancing from one to another almost as fast as the eye can follow him. He then turns the saw over, and bends the other half of the teeth in a similar manner, but in an opposite direction. There is a kind of bevel or slope in the small anvil, to effect a bending in the teeth of the saw.

These are the main features, such as we witnessed at the Saw-manufactory of Messrs. Hoole and Unsworth. Several minor details we may pass over, and the making of the handles we shall slightly notice in a future page.

Table-Knives.

A table-knife is perhaps the most important of the different articles of cutlery—not from its quality, for a razor is more highly finished; not from its intricacy, for a clasp-knife has more detail about it—but from the large extent to which the use has risen. Every house in England, except the very humblest, has as many table-knives in it as there are inmates; and most houses have a great many more. When we consider, too, that table-knives, as well as other articles, have the art of wearing away, and that the industry and the brickdust of the housemaid greatly hasten this process; and when we look abroad to notice the avidity which all rude nations exhibit to gain possession of an English knife—we shall be prepared to regard this as a very extensive branch of Sheffield manufacture.

There is in most of the operations on steel goods a series of processes pretty constant in their general character. The forging, the hardening, the tempering, the grinding, the sharpening, the polishing—all form steps in most of the series, and bearing a certain resemblance in their general character. A table-knife, for instance, is forged out of a piece of steel of higher or lower quality according to the price at which it is to be sold. The very commonest are probably not steel at all, being simply bar iron; the next quality may be common steel, the next shear-steel, and the highest of all cast-steel. But whatever be the material, a length of bar is cut off, sufficient for one blade, and forged into shape. All the Sheffield forges are pretty much alike. They consist of a forge-fire kindled by bellows; and have a large block of stone or wood, serving as a bench, and provided with small steel anvils, stitheys, bosses, hammers, and other instruments necessary to the operation. The piece of steel is heated in the fire, placed on an anvil and hammered into form; being turned over and about in every direction, and the workman regulating his blows according to the form which he wishes to produce, reducing the thickness from one end to the other, and from one edge to the other. But this relates to the blade only; the 'tang,' or part which goes into the handle, is a separate part. To make this tang, the rudely formed blade is welded to a rod of iron, about half an inch square; and a sufficient length of this iron is cut off to form the tang, and also the 'shoulder,' or the projecting part between the tang and the blade. The end of the iron is heated and forged so as to be reduced in size sufficient to form the tang; and the shoulder is next brought into shape by hammering it in a kind of die or stamp called a 'swage.' The tang and the bolster being made, the whole is heated a second time, and the proper form and dimensions given to it. The blade is then heated red-hot, and plunged perpendicularly into cold water, by which a sudden hardening is effected; and a gradual heating afterwards to a certain point gives the 'temper' or degree of elasticity best fitted for the purpose to which table-knives are to be applied.

[Forging Razor-blades.]

When the knives are thus far prepared, they are carried to the grinding wheels, where the blade is ground all over on a large revolving stone; whereby the surface is brought level, the edges made straight, or at least regular, the point rounded or tapered as the case may be, and the edge sharpened. The grindstones made use of for grinding table-knives are between three and four feet in diameter, and about six inches broad upon the face. They are formed of a species of sandstone, and revolve with great rapidity, without at the same time greatly heating the articles being ground. The knives are ground first upon this stone, and afterwards upon one of finer texture called the 'whitening stone.'

Here it may be well to notice the customary arrangements at Sheffield respecting the grinding of steel goods. As the town is dotted here and there with '*Tilts*,' so is it likewise with '*Wheels*;' and in the one case as well as in the other the name is an abbreviation well known among the townsmen. A 'wheel' is a building fitted up with a large number of grindstones, each hired at a weekly or yearly rental, by a grinder, who grinds some kinds or other of cutlery for other persons. Before the introduction of steam-power, the grinding wheels were in most cases situated by the side of a fall in one or other of the rivers of Sheffield, so as to obtain the action of a water-wheel; and these little structures often presented a picturesque appearance. But in modern times large buildings have been appropriated for this purpose, amply provided with steam-power. There is one building in particular, called the Castle Mills, situated near the junction of the Sheaf and the Don, which is especially calculated to illustrate this arrangement. It is a large castellated structure—open to the objection, perhaps, of exhibiting a style of architecture wholly inconsistent with the nature of the mechanical operations going on within. There is a central court-yard surrounded by buildings, and at different heights are galleries running round, with doors opening into numerous apartments on all sides. The south side of the building is adjacent to the river Don; but a steam-engine supplies the moving-power. If we go into the rooms of this building, we find men employed in grinding all the various kinds of Sheffield steel goods. In one room are men grinding saws, in another table-knives, in another pen and pocket knives, in another forks, in another scissors, in another razors; employing grindstones of all sizes from four inches to seven feet in diameter, and of varying quality. All are brought into connection with the moving power by means of the usual mechanism; and it is on these revolving stones that the grinding is effected.

In such places as this Castle Mill every man confines himself pretty nearly to one kind of work, and pays a rental to the proprietor for the use of the room and the steam-power; or sometimes a man hires a whole room containing several grindstones, and either employs others to work for him or sublets some of the room. When walking round the gallery, and looking in one room after another, we may see the men in their cramped attitudes (for it is never an easy one) bending over the grindstones, and engaged from morning till night in grinding articles of cutlery or other steel goods. These goods are not their own, but belong to others, who merely employ them as grinders.

But to return to our table-knives. When the knives are ground, they are ready for 'glazing' or 'polishing.' This is performed on a wheel called a 'glazer;' consisting of a circular piece of wood, fixed upon an iron axis, and coated on the edge either with leather, or with a ring of metal consisting of an alloy of lead and tin. The leather-faced glazers, used for glazing table-knives, are first covered with a solution of glue and then with emery powder; and it is by friction against this slightly roughened substance that the glazing of the knife-blade and shoulder is effected. The extent to which this process is carried on has led to the establishment of 'buff and glazer makers' among the trades of Sheffield.

Forks.

Fork-making is not without its peculiarities among the departments of Sheffield industry. Most of the fork-makers live in the environs of the town; and indeed there are one or two villages almost wholly inhabited by these operatives. Forks are in most cases made of 'common steel,' that is, blister-steel which has been drawn out under the hammer, but neither sheared nor cast. They are forged out of rods about three-eighths of an inch square, in the following manner:—The tang and shank of the fork are first roughly formed, by hammering out the metal while in a red-hot state; and being again heated, the proper contour is given to them by means of a die and swage or stamp. The prongs are formed by stamping with a powerful punch acting on the principle of the pile-driving machine, but of course with a force proportionate to the work to be done. There is a large anvil fixed in a block of stone nearly on a level with the ground; to this are attached two rods of iron of considerable thickness, fixed about a foot asunder, perpendicular to the anvil, and reaching to the ceiling; the hammer or stamp, weighing about a hundred pounds, grooved on each side, slides up and down by means of the iron rods, which act as guides; a rope, passing from the hammer over a pulley, gives the workman the means

of raising the hammer; and lastly, the lower surface of the hammer and the upper surface of the anvil are each provided with a die or stamp adapted to the cutting of the prongs. The blank fork, being heated to a certain degree of softness, is placed on the lower die, and the hammer containing the other die is made to fall upon it from a height of six or seven feet. This forms the prongs and the middle part of the fork, leaving a very thin substance of steel between the prongs, which is afterwards cut out by means of a fly-press. The forks thus brought to the form so familiar to us, are annealed by heating in an oven and then gradually cooling, so as to acquire a softness sufficient to enable them to be filed all round and between the prongs. After this they are hardened, by being heated and suddenly cooled

The grinding of forks is one of the most lamentable operations in the whole series of manufacturing processes, from its deleterious effects on the health. Forks are ground upon a dry stone, called the 'fork-stone,' formed of sharp grit of a whitish colour, very similar to that of which millstones are formed. The stone is about half a yard in diameter and two inches broad at the edge. The grinder sits on a 'horse' or stool, bends over the stone, holds the fork crosswise against the stone, and grinds all the parts of the surface to a smooth and even condition. If the stone were wetted, as in most other cases, the inconvenience would not be great; but the stone is kept quite dry, whereby not only is there a profusion of sparks given out, but the face and head of the grinder are enveloped in an atmosphere loaded with small particles of steel and grit-stone, which are inhaled into the lungs. Such is likewise the case in the process of needle-grinding; and in both instances the workmen infallibly fall victims to a distressing disease known as the 'grinders' asthma.' It is said that there are hardly any fork-grinders more than forty years of age, since the disease carries off most of them before they reach that time of life. When describing the Needle-manufacture at Redditch, in the Supplement for January, 1843, we alluded to the laudable endeavour of Mr. Abraham of Sheffield to devise a remedy for this sad evil, by placing a shield of magnets in front of the grinder's mouth, whereby the small particles should be arrested and prevented from entering the lungs. Another plan has been suggested by a Mr. Elliot; which consists in the adoption of a long box or wooden chimney, placed opposite to and partially covering the grindstone in front, while the other extremity is carried through a hole in the wall. In this arrangement it is said that such a current of air is excited by the mere revolution of the stone as to carry the dusty particles through this funnel into the open air outside the building. Yet both these plans have been rejected by the workmen, and so have all others having for their object the amelioration of this employment. Whether it is that the contrivances are very troublesome to arrange, or whether the grinders wish the occupation to remain unhealthy in order that wages may remain high (and both opinions have been expressed), certain it is that dry-grinding is still what it has ever been—one of the most disastrous occupations connected with the manufacturing arts; and it is equally certain that unless the men aid the attempts made for their comfort, all such attempts must be fruitless.

Pen and Pocket Knives.

A table-knife maker does not and probably cannot make a clasp-knife. He uses tools of different size, and his hand and his eye become accustomed to a kind of work from which he could not readily depart.

Penknives are generally forged by one man, with the hammer and anvil simply, the former weighing between three and four pounds, with a face or surface about an inch in diameter. The blade of the knife is first hammered out at the end of the rod of steel, and as much more is cut off along with it as is thought necessary to form the joint. The blade is then taken in a pair of tongs, and heated a second time to finish the joint part, a temporary tang or prong being formed at the same time. The blade is again heated, and hammered to a better and more correct form; and while yet hot, it is cut or stamped with a crescent-shaped chisel, to form the nail-hole, or notch by which clasp-knives are always opened. The blade is hardened by being brought to a red heat, and then dipped in cold water up to the shoulder.

The blades of pocket-knives, and of all other kinds of clasp-knives, are made nearly in the same way; and at a certain stage in the proceedings they are sent to a 'wheel' to be ground; after which they are 'glazed' on a leaden wheel coated with emery; and the finer kinds are still further polished on a circular piece of wood covered with buff leather, and coated with a paste or composition.

The finishing of a penknife is a curious instance of minute detail. When the pieces of ivory, pearl, tortoiseshell, horn, or bone, which are to form the outer surface of the handle, are roughly cut to shape; when the blade has been forged and ground; and when the steel for the spring is procured,—the whole are placed in the hands of a workman who proceeds to build up a clasp-knife from the little fragments placed at his disposal. So many are the little matters which he has to attend to, that a common two-bladed knife has to pass through his hands seventy or eighty times before it is finished.

When we speak of an 'ivory-handled,' or 'pearl-handled' penknife, the ivory or pearl is said by the workman to form the 'outer scale' of the knife, and is only for ornament; the real foundation of the handle being the 'inner scale,' which is formed of metal. The spring is the piece of steel which, running along the back edge of the knife, separates the two scales or halves of the handle; and by its elasticity exerted upon the tang of the blade, it secures the blade in certain positions—closed, half-closed, or open. The inner scales and the spring are both forged to the workman's hands, and his office consists in putting all the pieces together. He works at a small bench near a window, and is provided with a number of tools to facilitate his operations—such as a vice, a small anvil, hammers, several files, steel burnishers, a drill-bow and drills for boring holes, a glazer coated with emery, a polisher coated with oil and rotten-stone, steel-plates to act as gauges in making holes through the various parts of the knife, and a number of other little appliances which we cannot enumerate. With the aid of these he shapes and adjusts his various pieces, fastens them with pins or rivets, files down these pins to give them a neat and level appearance, polishes every part after it is fixed; and, in short, he does to a penknife what a watchmaker does to a watch—he makes very few of the parts, but he adjusts them all. Our concluding cut sketches the penknife-cutters at an establishment of which we shall presently speak.

Razors.

Here we come to a species of cutlery which has perhaps excited more attention than any other; respecting which more has been written; and in the preparation of which more care is taken. Commercially speaking, this department of manufacture is not so important as that of table-knives, from its much more limited application; but the good quality requisite to the fit action of a razor has made it an object of moment both to the steel-maker and to the cutler.

The blade of a razor is forged much in the same manner as the blade of a knife, but from steel of a particular quality. The rod of steel is heated at one end, and hammered into a shape bearing a rude resemblance to that of a razor. The concavity of the surface is produced by hammering the blade on the rounded edge of the anvil. The piece is then cut off, with an additional length sufficient to form the tang for insertion in the handle. The quality of the metal is required to be peculiar on this account, that the thickness of the back and the edge of a razor differs so greatly, that much hammering is necessary to produce the latter, and the hammering can only be borne by good metal. Some razors are made with a straight edge, some with a convex edge, some of equal breadth throughout, some wider at the point than near the handle, some short and broad, some long and narrow; but these are all differences to suit individual taste, and have little to do with the real quality of the razor.

Razors are generally tempered before they are ground; but sometimes ground before they are tempered. They are ground upon very small stones, often those which have been worn away to too small a size for other grinders. The reader may perhaps have seen or heard of razors *ground upon a 4-inch stone;* this character being mentioned as a test of excellence. What is here meant may be explained as follows:—every razor is concave or hollow on the surface; this concavity must be produced or maintained in grinding by the use of a stone equally convex. When a stone four inches in diameter is employed, it must give to the razor a corresponding concavity, or a curve of two inches radius; and it is evident that this can only be produced by wearing away the substance of the razor in such a way as to give a very thin edge. Now the thinner the edge, the finer and sharper can it be made in the process of 'whetting;' and hence there is an inference that, other things being equal, a razor "ground on a 4-inch stone" will yield a keener edge than one ground on a stone six, eight, or ten inches in diameter. On the other hand, any man who is blessed with a strong wiry beard will find that a very fine and delicate edge is spoiled almost immediately by it; he must have a razor whose edge possesses strength as well as keenness; and such a one must have been ground on a stone larger than four inches in diameter. Taking all these points together, therefore, it seems probable that the concavity of a razor ought to bear some relation to the kind of beard with which it is to be brought in contact; and that a medium concavity, produced by grinding the razor on a stone six or seven inches in diameter, is more likely to be generally serviceable than any other.—If the reader knew how many "Essays on Razors" have been written, and how earnestly all these points are discussed, he would see that they are not deemed so trifling as might at first appear.

The tempering of a razor is not less important than the grinding, since the fineness and durability of the edge depend greatly on it. This tempering, as we have before had occasion to observe, is given by exposing the article to a certain temperature, and then allowing it to cool gradually. This temperature is matter of experience. No one seems yet to know why a particular temperature gives a particular temper; there is no known general principle which pervades all the applications; and therefore each cutler or workman uses such a heat, and tests it by such signs, as seem best to accord with the result of his own experience. In general, the *colour* which the steel attains while hot is taken as the test, each kind of cutlery having a colour best fitted for itself. Others endeavour to use a thermometer to direct their proceedings; and we give the following table to show how the two have sometimes been worked out together:—

Fahr.	Colour.	
430°	Slight yellow	Fitted for razors and lancets.
450	Pale straw	
470	Yellow	Penknives.
490	Brown	
510	Brown, with purple spots	Pocket-knives, table-knives, scissors.
530	Purple	
550	Bright blue	
560	Blue	Springs.
600	Blackish blue	

We only give this as one instance of an attempt at system; for almost every distinguished cutler has favourite views of his own respecting the tempering of cutting instruments.

The razor, when ground, tempered, and polished, is fitted into its handle by means similar in character to those employed in handling penknives, but less complex.

It may be remarked, that among the points yet undetermined concerning the quality of razors, the condition of the iron whence the steel is made has not yet been fully understood. It has been supposed by some that steel, or the iron from which it is made, is improved in quality by being buried in the earth for a long time. A curious instance occurred a few years ago in illustration of this opinion. An eminent London cutler, having buried some razor-blades for three years in the earth, and having formed an opinion that the quality was greatly improved thereby, was desirous of obtaining some iron or steel which had been so buried for a much longer period. It happened that about that time old London Bridge was pulled down, and all the piles were found shod or pointed at the lower end with iron, which had been thus immersed in the earth for many centuries. The cutler bought all this iron, fifteen tons in weight, and had it converted into steel. The thicker portions yielded indifferent steel; but the thinner, which were both more sonorous and more tough than any other iron known, produced a kind of steel superior, it is said, to any that the cutler had previously known; so that it was said at the time, "We might mow our beards with a relic of old London Bridge."

It may be added, that iron is occasionally made of so good quality that it is capable of being formed into razors without previous conversion into steel. We have seen one made of Butterley iron, capable of rendering moderate, if not excellent service.

Scissors.

These implements of cutlery, though appearing to the eye more complex than knives and razors, are produced in a way very similar to them. In forging scissors, each half is of course made separately, by the aid of the forge, the hammer, and the anvil. The anvil of the scissor-forger is rather a large block of steel, having grooves on its surface for admitting various little indented tools called *bosses*. One of these bosses assists the workman in giving a proper figure to the shank of the scissors; another for forming that part which is to receive the rivet; and a third for giving a proper figure to the upper side of the blade. There are also contrivances to assist in giving shape to the bow or handle of the scissors.

The shank of the scissors is first formed by means of one of the bosses, leaving as much steel at the end as will form the blade; and a small hole is punched, to form the first semblance of the bow or handle. The form of the blade is then given, and the piece cut off from the bar of steel. The small hole is next enlarged,

by various implements, to the form and shape of the bow.

When many are thus forged, they are annealed to a state of greater softness, grouped together in pairs, and filed regular in all those parts which the grindstone cannot reach. The rivet-hole is then bored; and after being hardened and again tempered down to a particular point, they are sent to the wheel to be ground. The grindstone employed for small scissors is about the same size as that used for penknives; but the outer surface is ground on a larger stone. After the grinding, the scissors are glazed, and afterwards polished, if they be of the best kind. Since there are parts of the scissors which cannot be reached by the glazing and polishing wheels, a small wheel is employed having hard brushes on its circumference, the bristles of which penetrate to the intricate parts of the scissors, and polish them by means of emery or crocus.

As scissors are made from a farthing a pair to ten guineas a pair, every possible stage in the process, and every shade of difference in the quality of the material employed, are made to bear a proportion to the price at which the article is sold; but the above sketches forth the general routine. In large scissors the face of the blade only is made of steel, all else being made of iron; in cheap articles, the metal is cast at once into a scissor-mould, so as to save the expense of forging; in the costly kinds, the handles are chased, or etched, or studded with small ornaments, or inlaid with gold—according to the value placed upon them.

Handles.

We have more than once had to speak of the handles for knives, razors, and other articles of cutlery. These form an important and extensive department of Sheffield industry, leading to a vast consumption of material.

According to the technical phraseology applied, all handles are called *hafts* in which a tang of the knife passes into a hole in the handle, and is there fixed; while the handles which are formed of two flat pieces riveted to a central plate, as in penknives, are called *scales*. A 'haft and scale maker,' therefore (one of the trades of Sheffield), is in fact a handle-maker.

The workmen who engage in this employment confine themselves each pretty nearly to one kind of material. The pearl-handle makers procure the shells from the shores of India and Africa; these shells are about six inches in diameter, and are so extremely hard that they have to be wetted while being cut with a saw, to prevent the saw from being softened by the heat. This is a dirty occupation, and is accompanied by a

"—— very ancient and fish-like smell,"

elicited by the heat from the shell itself. The pearl, or rather mother-of-pearl, is cut up into thin slices, to be afterwards used for the scales for penknives, razors, &c. *Ivory* handles are made by sawing up elephants' tusks into the most useful pieces they can make, by means of a circular saw. If the ivory is for scales, it is cut into veneers; but if for hafts, it is cut into small oblong pieces, which are afterwards brought to shape by hand, polished, and pierced for the reception of the tang. *Bone* handles are similarly made by cutting with a small circular saw, and then filing into shape; and the same may be said of *ebony* and fancy-wood handles generally. *Saw-handles* are cut out of wood, which, after being planed to the proper thickness, is fixed in a vice, cut with a very fine saw, smoothed with files and glass-paper, pierced with rivet-holes, and riveted to the saws. *Metal* handles are, of course, made in a way similar to other articles of metal.

Horn handles have a peculiarity in their mode of manufacture, which places them in a distinct rank. When horn is made hot, it becomes so soft and ductile that it may be pressed into moulds; and this circumstance is taken advantage of to give an ornamental device to horn handles, except *stag's-horn*, which is left in its natural state. The tips or solid part of ox-horn and buffalo-horn are made into hafts, while the other parts are made into scales. The mould for pressing is in two halves, which close together like a pair of pincers; and this mould has the device on each of its halves. The mould is heated in a fire; the piece of horn is cut nearly to the requisite size, and put into it; and the mould is pressed in a powerful vice, whereby the horn receives the impress of the device.

[Cutting Ivory Handles with Circular Saw.]

There is also a good deal of skill shown in staining horn, bone, and ivory, or in bleaching them; as also in studding and ornamenting them in various ways.

System of Manufacturing.

All these departments of Sheffield manufacture, and others which we have not particularly noticed, are in themselves separate branches, and are only united in respect to the larger merchants and manufacturers. These manufacturers buy the steel from one or more firms, have it forged by another or several others, ground by others, and finished by others; or they will purchase ready-made goods from smaller manufacturers; or they sometimes advance money to workmen to purchase material, and then agree to give a certain price for the articles. In short, there are several modes of conducting the manufacture, but the *factory*

system is not one of them. By this we mean, that there is no large building, under a central authority, in which a piece of steel goes in at one door, and comes out at another converted into knives, scissors, and razors. Nearly all the articles of cutlery made at Sheffield travel about the town several times before they are finished.

There are, however, a few large firms which, besides selling all the various kinds of cutlery, manufacture largely on their own premises. The firm of Messrs. Rodgers and Co. is one of these. On visiting the show-rooms of this establishment a stranger can hardly avoid being struck by the display of manufacturing skill which meets the eye. Sheffield has long been the head-quarters of the cutlery trade; and we here see examples of what Sheffield skill can produce. Besides the bulk of manufactured articles, such as we find a sale in the common course of business, there are three or four highly curious specimens of workmanship to be seen. One is a clasp-knife not more than an inch in length when closed, and yet containing seventy-five blades, all perfectly and properly formed, and resembling in shape such as are customarily used in clasp-knives, but on quite a miniature scale. Every blade has its spring, hinge, rivet, and other appendages, so that it forms altogether a tiny, yet multitudinous knife. Another specimen is about two feet in length, and contains the enormous number of eighteen hundred and forty-one blades! It was made a few years ago, and then contained blades corresponding in number with the year in which it was made; since then a few others have been added; and it is, we believe, contemplated to bring up arrears by shortly increasing the number to eighteen hundred and forty-four, so that this may be a sort of a Sheffield almanac and a specimen of Sheffield knife-making at the same time. The blades in this splendid group are about the usual size. A third specimen, though having less than this number of blades, eclipses the other two in beauty. It is placed in a glass case on a rotating stand, and is about thirty inches in height. It contains two hundred and twenty blades, all of large size, and most of them exquisitely engraved, or rather etched, with portraits of distinguished persons, views of the chief buildings in Sheffield, and other subjects. These pictures being of a dead white appearance, on steel having the most brilliant polish that art can impart to it, and being skilfully done in respect to drawing, the whole assemblage is strikingly beautiful. Such parts of the handle as present a flat surface are of pearl, studded with jewels; and it is said that a sum of between seven and eight hundred guineas was expended in wages alone in the production of the knife!

Many persons may perhaps occasionally have seen curious little specimens of cutlery, in which the object seems to be to try how much can be done in a small space. One such is included among the curiosities of this show-room. It consists of a group of ten pairs of scissors, each complete in itself, each about one-tenth of an inch in length, and the whole ten weighing rather less than a grain; or (to give a familiar standard) it would take nearly five hundred such pairs of scissors to weigh as much as a silver sixpence!

With respect to the workshops of this firm (excluding those relating to the manufacture of plate and plated goods, which we do not notice here), they exhibit many of the branches of manufacture which have been occupying our attention. There are ranges of forges, and other portions of the apparatus for manufacturing cutlery. Yet even in this establishment it would be impossible to trace the manufacturing history of a knife without following it to other workshops in Sheffield. And such may be said of the larger firms generally, as well as the smaller ones. Each class of manufacturers is so dependent on the others, and there is such a chain of links connecting them all, that we have found it convenient to speak of Sheffield as one huge workshop for steel goods.

[Penknife Cutlers, Messrs. Rodgers's, Sheffield.]